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Teaching and learning in the school garden

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TEACHING AND LEARNING IN THE SCHOOL GARDEN

A Project

Presented to the

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in

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by

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ABSTRACT

This project was created to encourage educators to establish school site gardens. Gardens provide the opportunity to introduce environmental topics, and can become hands-on learning centers for subjects across the course of study.

The project includes basic gardening information, tips on establishing a school garden, and additional educational garden resources to help teachers get started. Curriculum links are offered as examples of how to include various disciplines in the garden program. Garden-based teaching strategies are correlated with the State of California frameworks for science, social studies and history, language arts and math.

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TABLE OF CONTENTS

CHAPTER ONE

INTRODUCTION

As we settle into the twenty-first century, the challenge for the future is to create an ecologically sustainable way of life which will satisfy our needs without sacrificing the future. "We need to become ecologically literate, and the best place to acquire ecological literacy is the school garden (Capra, 1999, p. 45).

The study of ecosystems, the sustainable communities of plants, animals, and microorganisms offers valuable lessons in the basic principles of ecology. The garden provides students with the opportunity observe these systems at work. Plants have their season, and then die. Insects work to help breakdown the dry plants. With the help of the decomposer organisms, the plant's basic elements will be returned to the soil to sustain the growth of new plants.

As students' academic and environmental knowledge grows, they can absorb more complex principals of nature. For example; "green plants play a vital role in the flow of energy through all ecological cycles" (Capra, 1999, p. 46). Photosynthesis converts the sun's energy into a form that humans and animals can eat, and that we can burn for fuel.

When students have a enhanced appreciation of the systematic nature of the environment, "[they will] have a better understanding about the interplay between living things and their non-living support systems, such as the ozone layer and weather cycles (Wann, 1994, p. 2). This assimilation of the "bigger picture" is important if the next generation is going to learn to think in terms of sustainability.

> School gardens challenge students with an endless variety of systems through which to learn the principles of ecology, 'the language of nature.' A garden system provides a living context in which to study these principles: interdependence, diversity, cycles, scale and limits, energy and resources, succession and sustainability. (Life Lab Science Program, 1999, p. 6)

Students need environmental ethics as well as environmental intelligence to guide their decisions in the coming years. Environmental sensitivity is developed and nurtured by experience in the environment. Teachers can provide outdoor learning opportunities and model respect for the environment in a school garden. Hart has found that if children have a caring adult "who has a stewardlike relationship with the land they are in really good shape for developing a close relationship with the natural world" (1999, p. 7).

Researchers have ample evidence to show that gardening can become the basis for developing an affinity toward the environment (Harvey, 1989/90; National Gardening Association, 2000; Turner, 1999). Studies also demonstrate the academic benefits of participating in a garden program, including better performance on standardized tests and increased enthusiasm for learning (Leiberman & Hoody, 2000; National Gardening Association, 2000; Texas A&M, 2000).

School gardens can be used to teach a wide range of instructional objectives through a variety of teaching modes. Educators can use the garden to incorporate subjects from all disciplines.

This project was designed as an impetus to encourage teachers to incorporate gardening activities into their course of instruction. The curriculum links are arranged to show ways to work toward the benchmarks and standards using a school garden.

Gardening programs are inter-active learning at its best. They support academic growth, enhance the school site, and are an avenue to introduce environmental awareness.

In order to build a sustainable future, students need to have information, and the opportunity to connect data to that which is real and meaningful.

They also need ethical guidance, and the chance to develop an affection for the environment. And it can all start in a garden.

CHAPTER TWO

LITERATURE REVIEW

Our future depends on people with an educated environmental ethic. As we face environmental concerns from global warming to genetic engineering, it is vital that we develop informed opinions. "The relationships of ecology and the human mind are too intricate to be understood entirely by unaided intuition, by common sense - that overrated capacity composed of the set of prejudices we acquire by the age of eighteen" (Wilson, 1984, p. 120). Yet environmental studies can hardly be found in colleges let alone high school, or elementary school.

The current trend in education is to compartmentalize academic goals as if each area of the curriculum can be tackled independently. Responding to the pressure to elevate test scores, in many schools teachers have removed science and social studies from the curriculum (art and music having long been laid to rest). With the tacit approval of administrations, classroom lesson planning has been narrowly focused to "teaching the test."

In real life however, we need to integrate all aspects of our education including language arts, math, science, social studies, music and art to function effectively in

society. Further, this assimilation of information helps us to formulate our values and social conscience. A fundamental component of environmental education is the development of an "environmental ethic." An environmental ethic is not an absolute premise, like a set of rules to be memorized. Rather, environmental ethics or values are created by experience and education. They guide our behaviors and decisions with a vision toward the future we cannot see, and to the benefit of generations we will never know. "Only through an unusual amount of education and reflective thought do people come to respond emotionally to far-off events and hence place a high premium on posterity" (E. O. Wilson, 1984, p. 120).

The goal of education is to prepare young people for the future. There is disagreement however as to the focus and shape of the future. Central to the debate on the role of education is the recognition of our expanding global economy. The economic view of the future is concerned primarily with emerging economic problems. Yet, [the] "largely limited focus on the school as a site of economic renewal, ignores a much more substantive problem related to the deepening environmental impasse and the role of the human in disrupting the ecological stability of the planet" (Hutchinson, 1998, p. 1).

Many environmentalists feel that during the modern era we have gradually eroded life systems and the ecological process of the planet such that our present way of life is no longer viable. There is concern world wide about economic growth that does not sacrifice indigenous cultures and the environment.

Nagpal noted that the idea of sustainable development, introduced by the World Commission on Environment and Development in 1987, is to meet the needs of the present without compromising the needs of the future (1995).

While the means and methods of sustainable development are subject to discussion, "Few would contest that we have an obligation to future generations: not to leave them an impoverished Earth and fragmented societies" (Nagpal, 1995, p. 205).

An assumption of the industrialized nations has been, with human ingenuity and technology the whole world will eventually be able to live like middle-class Americans. However, considering that the U.S. consumed one-twentieth of the world's energy in 1988, it is clear that we cannot reproduce our lifestyle at global proportions (Ristinen & Kraushaar, 1999, p. 20).

Additionally, with current accounting methods many of the "true costs" of the industries that support our

lifestyle (ie., agriculture and manufacturing) are not counted in the cost of production. Soil erosion, ground water pollution, acid rain and green house gases are some of the costly by-products of our industrialized economy. Yet the damage to public health and the environment is not factored in to the cost of production. For example,

> Agriculture has become progressively more dependent on fuels at an uncalculated cost to the environment from the extraction, processing, transport, and combustion. Food packaging is another source of environmental costs. One third of the solid waste stream is food packaging. David Pimentel has estimated that the total unpriced cost of the U.S. food system fall between $150 and $200 billion dollars per year. (Orr, 1994, p. 173)

The economic and biophysical reality of our economy is "We have a growth that impoverishes rather than enriches" (Ellwood, 1996, p. 203). What has been good for business, more production and more consumption, has been assumed to be good for the country. Yet clearly, the practices of the past are not sustainable. "It is now estimated that 40 percent of what ecologists call the "net primary production' (NPP) of the earth's natural ecosystems is diverted to human activities (Ellwood, 1996, p. 203). This is with only a fraction of the world's population living in affluent industrialized nations.

Hutchison,(1998) and Orr (1994) believed that schools should play an active role in responding to the environmental and related economic challenges.

Orr stated, "It makes far better sense to reshape ourselves to fit a finite planet than to attempt to reshape the planet to fit our infinite wants". Education should encourage understanding and appreciation for the "fragile state of the plant's life systems [and] the role of the human within the larger context of the earth community" (Hutchinson, 1998, p. 40).

Hutchison and Orr both felt schools have the opportunity to instill ecologically sound values, attitudes and behaviors. They proposed a "holistic" approach to education which integrates curriculums and includes the development of ideological frameworks. Further, Hutchison believed there is a relationship between environmental philosophies of education and ecologically sensitive theories of child development.

Environmental education is constructivist in nature. Students are required to take an active role in learning and building on prior knowledge using critical thinking skills. Learners are challenged with more difficult tasks as they are developmentally ready. Heimlich noted an analysis of research by Hines, Hungerford and Tomera (1987) in which they "identified four factors that comprise environmental education: (a) knowledge of environmental issues; (b) knowledge of specific action strategies to apply to the

issues; (c) the ability to take action on environmental issues; and (d) the ownership of certain affective qualities and personality attributes" (2001, p. 2). Heimlich went on to state that using these factors as a basis for constructing learning, academic areas become less distinct. As life skills are developed, the learner is driven by the "need to know." "The result is not only an acquisition of traditional knowledge cognitively, affectively, and behaviorally, but also an ability to transfer such learnings" (2001, p. 2). Environmental education also expects students to act on issues consistent with their knowledge and understanding. The goal is to develop thinking, involved individuals.

In his book Growing Up Green Hutchison outlined a "methodology and curriculum for an ecologically sensitive approach to education in middle childhood, emphasizing the child's search for a working theory of the universe and other developmental insights" (1998, p. 5). He framed his system around a holistic view of education.

Hutchison described the holistic educational philosophy stating "the connections which bind objects and phenomena together are just as important as the objects and phenomena themselves" (Hutchison, 1998, p. 49). A holistic approach to curriculum would insure that students understand the

relationships between economic development and costs to the environment and humanity. Holistic educational ideology includes the search for "guiding metaphors" based on students understanding of their cultural values.

Hutchison and Orr shared the belief that it is vital for students to learn to make connections between natural and man-made systems and that they reference an ethical framework in their analysis.

Orr submits that all education is environmental education. "By what is included or excluded, students are taught that they are part of or apart from the natural world" (1994, p. 12). As our society is increasingly urban and suburban, children are further and further removed from the natural world. Studies show that the average American spends the majority of his or her time indoors.

When young children are effectively isolated from direct contact with the natural world, they ten to develop irrational fears and feelings of revulsion in relation to natural objects. "The result is that many young children are at risk of never developing positive attitudes and feelings toward the natural environment" (R. Wilson, 1996).

Children need an early introduction, and frequent interaction with the environment to develop an affinity for nature and an environmental conscience. Environmental

rapport cannot be developed by studying textbooks indoors.

Children need guidance and modeling to develop environmental sensitivity. The need "education 'in' the environment where experiential learning fosters both awareness and concern for the environment" (Haury, 1998, p. 3).

Hutchison, Orr, Wilson and Hart wrote of the opportunity to teach about the environment within the context of a school garden.

> Tending a garden reinforces basic values related to responsibility and care, but such an exercise also actively involves children in an ongoing study of the cyclical process of growth, decay, and the rebirth of life. . . . When such projects are carried on over a period of successive years, a genuine link is forged between children's gardening endeavors and the moral/character goals of instilling ecologically sensitive values and skills related to children's interaction with nature. (Hutchison, 1998, p. 135)

Ask most city children where their food comes and they are likely to say the supermarket. Some children have a vague notion of the origin of a few items such as tomatoes, but most are unable to trace the food chain beyond the commercial vendor. "This inability to relate the nourishment one receives to the sustenance provided by the wider earth community is symptomatic of a culture that has largely lost touch with its dependence on the natural world" (Hutchison, 1998, p. 134). A school garden can counter act such a loss.

The school garden can be the setting for daily or weekly investigation and interactions. Children can follow the seasonal changes and begin to understand life's cycles in the garden. They also learn patience and nurturing tending to a garden.

> . . . the caring part is reminding everybody that this [environment] is all much more difficult than we can ever completely understand; there's something about the integrity of a natural system that is worth treasuring, because of the preciousness of life, of all living things. (Turner, 1999, p. 7)

Roger Hart, the author of Children's Experience of Place, believed children need to spend time in the environment with adults who demonstrate a "stewardlike" relationship toward the land. This helps the children develop a "close relationship with the natural world" (Turner, 1999, p. 7). Hart went on to say that children need to have and ongoing involvement with an ecosystem, observing the area over time and through seasons to understand the complexity of a natural system. He believed the school site should provide the opportunity for children to interact with the environment.

Hart's assessment is supported by recent research in England regarding the impact of the school landscape on children's botanical knowledge and their environmental dispositions. Harvey's summary of the study found that children in schools with "developed" school landscapes

(significant, and diverse vegetation) showed more advanced general botanical knowledge. These children also rated higher on tests measuring environmental dispositions. The author concludes by saying the relevance of the study is not in the increased botanical knowledge, for few schools even offer the subject. The value in the school landscape was the influence on the students attitudes and values in improving their feeling of concern for the environment (Harvey, 1989/90).

As children grow, their curiosity and wonder become the impetus for further learning about other aspects of their environment. In addition, a child's joy in their environment can lead to a sense of stewardship. "The aim of education is to provide children with a sense of purpose and a sense of possibility, and with skills and habits of thinking that will help them to live in the world" (Waters, 1999, p. 17).

In the garden, children discover their own impact on the environment and can begin to make responsible decisions.

> Learning in the school garden is learning in the real world at its very best. It is beneficial for the development of the individual student and the school community, and it is one of the best ways for children to become ecologically literate and thus able to contribute to building a sustainable future. (Capra, 1997, p.46)

In Chawla's meta analysis of research to determine influences that led to effective environmental activism, it was found that "people described childhood as the foundation of their relationship with the environment" (1999, p. 17). The activists she interviewed cited their experience with nature and adult modeling as critical to the development of their environmental ethic. The major determinate of responsible environmental behavior is "*environmental sensitivity*, which functions as a prerequisite or, at the least, a variable 'that would enhance a person's decision-making;' in determining to act responsibly" (Chawla, 1999, p. 24; emphasis in original).

Project GREEN, Gardening Resources for Environmental Education Now, is a gardening program designed by Texas A&M graduate student Sonja Skelly. The goal of the project was to help teachers integrate environmental education into their math and science curriculum using the garden as hands-on tool. Skelly used pre and post-tests to evaluate the participating children's environmental attitudes. After one semester in the program,

> Students in gardening classrooms scored significantly better than those in control classrooms on measures of appreciation for the environment and concern about human impact. (National Gardening Association, 2000)

Those students also showed a more positive attitude toward school (Waliczek, 2001).

In addition to the impact on children's environmental conscience, research shows students receive academic benefits from participating in gardening programs. In 1992, Barbara Sheffield, from Columbia, South Carolina (in National Gardening Association, 2000) conducted a summer school project that used a whole-language approach with gardening as the central theme. Results of formal pre and post-tests of achievement showed gains in reading, reading comprehension, spelling, and written expression.

That same year, the National Gardening Association studied third and fifth grade classrooms using the GrowLab curriculum. (GrowLab is a garden based science oriented curriculum.) The students in the GrowLab classrooms scored significantly higher [than control classrooms] in key life science concepts and science inquiry skills (National Gardening Association, 2000).

Researchers at Texas A&M University found that participation in a school garden program "increases students' self-esteem and decreases classroom behavioral problems" (Growing Minds, p. 5). Studies at Our Lady of the Lake University "suggested that students developed increased responsibility in caring for living things, as well as an increased compassion for other people in their community" (Growing Minds, p. 5).

School gardens are not the panaceas to environmental education. However, they are an option to introduce children to the outdoors. Gardens provide a safe environment for children to investigate and explore the natural world around them. School gardens are avenues to discover and debate environmental issues and philosophies as well as hands on learning centers.

In the future, our students will be called on to make decisions regarding the wise use of our global resources. Because our values are cultural and time dependent, we cannot rely on conventional wisdom alone to be sufficient to secure a world worth inhabiting. Our children must be able to see beyond the near future and anticipate the world they will leave to distant generations. These decisions are best made with scientific understanding and an environmental ethic. "Forming an environmental ethic extends beyond the cognitive realm to include the attitudes, values, feelings, and actions involved in gathering and producing knowledge" (Knapp,1999, p. 143).

A school garden is a small step in the direction toward environmental awareness. For many schools it may be the only example of environmental education, and therefore all the more important to begin the process.

> School gardens . . . turn pop culture upside-down. They teach redemption through a deep appreciation for the real, the authentic, and the lasting-for the things that money can't buy-the very things that matter most of all if we are going to lead sane, healthy, and sustainable lives. (Waters, 1999, p. 15)

CHAPTER THREE

GOALS AND OBJECTIVES

School gardens provide hands-on, experiential learning opportunities. They can be an instrument to enhance current curriculums, as well as a venue to introduce environmental issues.

As recognition that school gardens can be an important part of the curriculum, the California State Legislature passed Assembly Bill 1014 in October of 1999. The bill was put forth to "establish the Instructional School Gardens Program for the promotion, establishment, and support of instructional school gardens. . . ." (Assembly Bill 1014). This bill creates an addition, (Article 8.5) to the Education Code, to read:

51795. The Legislature finds and declares all of the following:

> (a) School garden projects provide an interactive, hands-on learning environment to teach composting and waste management techniques and the fundamental nutrition concepts embodied in the Dietary Guidelines for Americans and to foster a better understanding and appreciation of where food comes from, how it gets from the farm to the table, and the important role of agriculture in the state, national, and global economy.
> (b) Encouraging and supporting a garden in every school creates opportunities for children to make healthier food choices, participate more successfully in their education experiences, and develop a deeper appreciation of both their community and each other.

> (c) Garden programs can equally enhance any subject area including science, environmental education, math, reading, writing, art, physical education, history, and geography. As California continues to strive toward improved pupil performance, the garden project provides a unique method through which it can be achieved. (California Assembly Bill 1014, 1999)

Realizing the value of a school garden as a setting for enhancing environmental awareness, integrating other areas of the curriculum and many teachers' desire to be involved in a school garden, the goal of this project is to provide:

1. Information for creating a school garden.
2. Garden basics.
3. Grade level curriculum links which incorporate the garden into the required subject areas, and include State of California standards and benchmarks.
4. Resource lists.

CHAPTER FOUR

DESIGN OF THE PROJECT

This project is designed to stimulate teachers' creativity in fashioning avenues to include garden activities into the required curriculums.

There is an abundance of good material available to help teachers integrate a range of topics, including school gardens into their science and general curriculum. Yet, too often these resources languish on bookshelves and in storage. Why do educators ignore these ready-made opportunities to spice up their lessons and broaden the curriculum? In informal interviews, "time" is the reason most often cited. The current emphasis on language arts and math too often excludes time for any other subjects. Many teachers have stated their desire to be involved in gardening projects but feel they can not "justify" the time spent on apparently "fun," or "frivolous" activities.

To support educators intuitive understanding of the value of hands-on learning, and highlight the importance of environmental literacy, this project was designed incorporate a variety of disciplines into garden related activities.

The first part of this project provides the philosophical foundations and the sociological imperative for environmental education. References to research demonstrate the efficacy of using a school garden as a basis for environmental education as well as the context to integrate subjects across the curriculum. Further citations note the academic benefits of students' participation in a gardening program.

Curriculum links offer examples of the many ways to tie subjects together through activities in the garden. Information on creating school gardens, and basic gardening advice is provided as a guide for teachers inspired to establish a school garden. The plan concludes with avenues for funding and additional garden related educational resources.

CHAPTER FIVE

IMPLICATIONS FOR EDUCATION

Too often we treat environmental education as though the "environment" were confined to certain locals. We condemn the burning of the rainforest, while over looking environmental disasters closer to home. School gardens offer the opportunity to address environmental issues in a meaningful way. The decision to use, or avoid chemical fertilizers, pesticides or herbicides can fuel discussions that lead to the development of an environmental philosophy and conscience. Younger children learn that some insects are beneficial to the garden, while older children can discuss the larger issues of chemicals in our environment. Topics such as biogenetic engineering of commercial food crops can lead to greater scientific knowledge and will help students begin to develop an environmental ethic.

Environmental awareness evolves naturally as children become involved in the growing process. Gardens provide the opportunity to incorporate other curricula into the gardening program as well. Science, math, language arts, music and art can all be addressed within the context of the developing garden.

To emphasize the importance of environmental education, former President Clinton's Council on Sustainable Development outlined an agenda of action for "Education for Sustainability." Included in the six strategic initiatives is the recommendation to implement "Interdisciplinary approaches that provide themes to integrate content and issues across disciplines and curricula." (Haury, 1998, p. 1). For students to understand the relationships between natural systems and economic development, they need a comprehensive educational experience that helps them understand the "interplay between living things and their non-living support systems, such as the ozone layer and weather cycles" (Wann, 1994, p. 2). Integrating subjects "attempts to provide students with the opportunity to connect and integrate what they are learning to their surroundings" (Lieberman & Hoody, 1998, p. 7).

Many educators have long recognized the value of the hands-on, problem solving teaching techniques followed by environmental educators. However, the perceived value was based primarily on anecdotal evidence rather than intensive research. To document the effectiveness of these educational practices the State Education and Environment Roundtable formed a study team. The Roundtable members designed a an evaluation survey to ascertain the effects on

learning and instruction using the environment as an integrating context(EIC)in K-12 schools.

> EIC-based learning is not primarily focused on learning about the environment nor is it limited to developing environmental awareness. EIC programs typically employ the environment as a comprehensive focus and framework for learning in all areas: general and disciplinary knowledge; thinking and problem-solving skills; basic life skills, such as cooperation and interpersonal communications; and last but not least, understanding of and appreciation for the environment.(Lieberman & Hoody, 1998, p.7)

In Closing the Achievement Gap, Lieberman and Hoody, catalogued the results of a nationwide study of schools that used the environment as an integrating context for learning. Lieberman and Hoody found a positive correlation between the EIC formatted curriculum and test scores, attitudes and attendance.

> The observed benefits of EIC-based programs are both broad-ranging and encouraging. They include:
>
> - better performance on standardized measures of academic achievement in reading, writing, math, science, and social studies;
> - reduced discipline and classroom management problems;
> - increased engagement and enthusiasm for learning and,
> - greater pride and ownership in accomplishments (1998, overview).

The study found the EIC format of integrating curriculums advanced student performance throughout the subject areas, and enhanced the total school experience. "Furthermore, schools that analyzed standardized tests and

grade point averages (GPAs) found that EIC students consistently perform better in terms of academic achievement than their traditionally instructed peers"(Lieberman & Hoody, 1998, p. 19).

What this means to educators is now there is hard evidence to support what many have already experienced. Hands-on learning, like the kind of learning that takes place in a garden supports academic skills and improves classroom behavior.

The instructional beauty of a school garden is in its versatility. It can be used to teach a wide range of educational objectives, through a variety of teaching modes.

> For kinetic learners, the garden allows the hands-on exploration that they need for effective learning. Intuitive learners find that the garden allows them to make predictions and to see how those predictions work out in a concrete manner. For children who struggle with small motor skills, the garden helps to develop such skills as they work with seeds, seedlings, and weeding in a manner that is enjoyable. For children who are imaginative, the garden becomes a source of inspiration for adventures. For visual learners, there is much to observe. (Kidsgardening, 2001)

As an added benefit, researchers at Texas A&M and the University of California at Davis found that student's attitudes toward (eating) vegetables improved significantly after participating in a gardening program.

The visual beauty of the school garden is also a psychological benefit to the whole school community.

It is evidence the staff and students care about their learning environment. Participation in a garden program gives students a sense of ownership in their school. They also learn to work cooperatively when they work toward common goals. Waiting for seeds to sprout develops patience, and keeping the weeds at bay teaches perseverance.

By following the planting seasons and the cycle of plant growth students become more attuned to the rhythms of nature tending a garden. Finally, a mature garden is a source of pride for the students who worked hard to bring it to life.

There are so many good reasons to install a school garden. In addition to the academic benefits, students learn valuable personal and social skills, and the school environment is enhanced in the process.

APPENDIX

SCHOOL GARDEN HANDBOOK

Creating a School Garden: Laying the Foundation for Success

School gardens can be found in a range of settings, in urban, suburban and rural communities, in both warm and cold climates. Gardens can grow in the absence of bare land and even where space seems limited. Each school must adopt a strategy that works in their situation, tailoring the garden to fit their school's needs (Life Lab Science Program, 1997, p. 9).

Successful school gardens share a common characteristic. They were all started as a result of the vision of one or two people with a dream and dedication. These garden leaders might be teachers, administrators, or volunteers. The important trait they share is their understanding of the school garden as a teaching and learning tool. They know that the garden provides hands-on learning opportunities that "foster children's experience

and understanding of the natural world" (Barlow, 1997, p. 79). They also know the presence of a garden can positively impact the psychological climate of the whole school.

Once the decision has been made to create a school garden consider keeping a journal. A garden notebook is a good way to stay organized, track progress, and store garden related information. Take pictures of the different phases of the garden development and keep the pictures in the journal as well. Include a planning checklist and leave room for notes in the notebook. This is also the place to keep a list of garden contacts, suppliers, and grant information.

With a garden journal in hand, before a spade ever touches the soil, review the following suggestions for laying the garden's foundation for success.

Purpose. Teachers interested in establishing an instructional garden should determine the garden purpose. How will the garden support or enhance the current curriculum? Educators need to consider how they will use the garden setting and how they will tie their classroom time in the garden to teaching the benchmarks and standards (of their district and state). There will be many opportunities for students to apply knowledge and skills

they have learned in one subject area to the work they are doing with their garden.

Support. It is critical to the success of the gardening program to have the support of the school administration. If the garden is going to include more than one or two classrooms, assess teacher interest and commitment. The garden program will eventually require volunteer time. Think about where you might find garden volunteers. The PTA, service groups, parents and retirees are all potential garden volunteers.

Steering Committee. The success of the gardening program can depend on the commitment of as few as one or two people. However, it is better to have a core of enthusiastic garden leaders forming a steering committee to keep things coordinated and moving forward.

The steering committee will determine the layout and organization of the garden. They will establish garden protocol, such as plot "ownership," and rules for working in the garden. The steering committee will also coordinate garden workdays that require large groups of volunteers.

Location. The location of the garden will be determined by several factors. First, the site needs at least six hours of sunlight each day. Second, there needs to be access to water nearby. Third, the garden area needs

to be secure. Sometimes having the garden out in the open, in plain view of the school population and visitors is all the security that is necessary. However, some school gardens may require fencing. Generally, the more students, teachers, and community members are involved in the garden, the less likely it is to be a target of vandals.

Other factors influencing the location of the garden include accessability, space, safety, and district regulations. Every school site is unique and with creativity, school garden enthusiasts can overcome each of these concerns.

Designing the Garden. The garden site, its purpose, and the number of students and teachers participating in the project will all have to be considered in the garden design. Ideally, a school garden would include:

1. Outdoor classroom and meeting area.
2. Planting areas for each classroom.
3. Community growing area.
4. Special project area for student experiments.
5. Compost area.
6. Tool shed or storage area
7. Sink

It may not be possible to include every item on this list. Classrooms could share space, and a hose can

substitute for a sink. Special projects may have to move back and forth to the classrooms if the garden area is not secure. Tools can also be stored in classrooms until a storage shed is available. It is more important to get started than to wait for all the right conditions and accessories.

At the middle and high school level, students can be involved in the garden design process. Some schools encourage each class to design their vision of the garden and then pick the best elements from each rendering for the final plan. Elementary school children can help to lay out their individual classroom plots.

Garden Themes. The theme of the garden will also influence the design. Will the garden have vegetables or flowers, or both? Are classes planning to work independently or as groups? Is there one over-all garden theme, or will each class choose their own composition? How will the theme of the garden be determined? The steering needs to answer these questions in connection with creating the garden layout.

Some examples of garden themes include:

1. Vegetable garden.
2. Butterfly garden (grow plants that attract butterflies).

3. Pizza garden (grow the ingredients to a pizza).
4. History garden (grow a garden from a significant time period).
5. Native plant garden (grow plants native to the local).
6. Literary theme garden (for example, grow the vegetables listed in Mr. McGreggor's garden).

An overall theme for the garden provides structure and direction and gives the garden personality. For more information regarding garden themes see the section, Garden Themes.

It is also a good idea to name the garden. Each class can distinguish their own garden plot, but the larger garden area should also have an identity.

Garden Signs. Let the school community and visitors know what the garden is all about by posting garden signs. One sign should announce the name that was chosen for the garden. Other signs can identify the project and the learning goals. Garden signs can also be used to list rules for the garden space and to thank donors. Students should be involved in designing the school garden logo, as well as the signs for their class garden. If the students are older, they can compose and manufacture all the garden signs as a class project.

Tools and Storage. Start with anything available. Garage sales and borrowed tools are a good beginning. As the garden takes shape, many times parents and other community members will come forth with donations including garden tools. Store the tools in a classroom or other easily accessible location until funds are available to purchase a storage shed.

Funding. There are many potential sources for garden funds. Some schools may be eligible for district money, or money from special funds. Also, check with the PTA to see if they can provide support. In addition to cash donations, the PTA might also be willing to sponsor or assist with fund raising efforts to benefit the garden. Community members and local businesses may also be willing to donate money or materials toward the garden.

Grants are another source of revenue and supplies for the garden. Grant opportunities are listed separately under Funding the Garden.

The important part of getting a school garden underway is just getting started. As the commercial says, "Just do it." Start small and know that the garden will evolve. If teachers approach the gardening process as yet another project that is filled with obstacles, the students will see it that way too.

The garden should not become one more activity that requires many purchased accessories and specialized equipment. Its fine if the garden is so successful that it eventually includes sheds, greenhouses, and other luxuries. However, none of these items are necessary to get started. To quote another familiar line, "If you build it, they will come." Students, teachers, and the community will respond to the most humble gardening attempts. From there will come volunteers, aid and assistance to expand the garden program.

The gardening process springs from our innermost need to connect with the land. Watching seeds sprout and flourish is satisfying under the most modest circumstances. Further, children learn from gardening failures as well as success. Therefore, start small, involve the students as soon as possible, as much as possible. Learn with the students, and be prepared for the garden to grow and change as interest in participation increases.

School garden projects nurture community spirit, common purpose, and cultural appreciation by building bridges among students, school staff, families, local businesses and organizations.

Young people can experience deeper understandings of natural systems and become better stewards of the Earth by designing, cultivation, and harvesting school gardens with their own hands. (Eastin, Vision, 1999)

Creating a School Garden:

Getting Started

Once the garden steering committee has been established, before any physical work begins on the school garden, the committee should take the time to visit other school gardens. Interview the teachers involved to find out what has worked and, what problems they may have encountered. Also, look for gardening workshops in your area. Check with the agricultural extension office, the local Master Gardener program, University of California extension school and nurseries for information regarding any upcoming workshops. Even if the first workshops you attend are not specifically aimed at developing school gardens you will gain information and may make some valuable gardening contacts.

Some of the U.C. Master Gardeners have, or are developing programs to work with school gardens. They can be a good source for volunteers and advice. Additionally, there is a Junior Master Gardener program designed for schools or clubs. They have an excellent curriculum that is tied to the California and Texas benchmarks and standards. Junior Master Gardener is sponsored by Texas A&M University, the contact information is included in the resource list.

After acquiring some background knowledge, the steering committee should create a calender for developing the school garden. The plan is a guideline and will have to be flexible. Garden work days may be changed by weather or other factors that cannot be controlled, or anticipated. Still, the outline will help keep the garden progressing in an orderly manner.

When designing the garden layout, start small. It is better to expand if the school staff has increased interest in participating in the garden. However, a large plot can become an eyesore if teacher participation drops off. An important part of the garden plan is determining plot divisions, and responsibility for planting and maintenance.

In considering the garden form, the steering committee needs to decide if there will be an over-all theme, or if individual teachers will decide how to use their own space. Ideas for garden themes can range from a "Pizza Garden" to a storybook garden to a historical garden. For more ideas on garden themes see the section, Garden Themes.

When it is time to start physically preparing the garden, get the word out. Make flyers to send home with students, contact the PTA, and put up notices in the staff lounge. Encourage student participation.

Smaller children should be accompanied by a parent or other adult, but older children may work independently. It is important that the students see the garden develop from the beginning. When they participate in the creation, it instills ownership and pride in the garden. It also helps them understand garden fundamentals. The majority of our urban and suburban children are so removed from agriculture many of them have no idea where their food comes from.

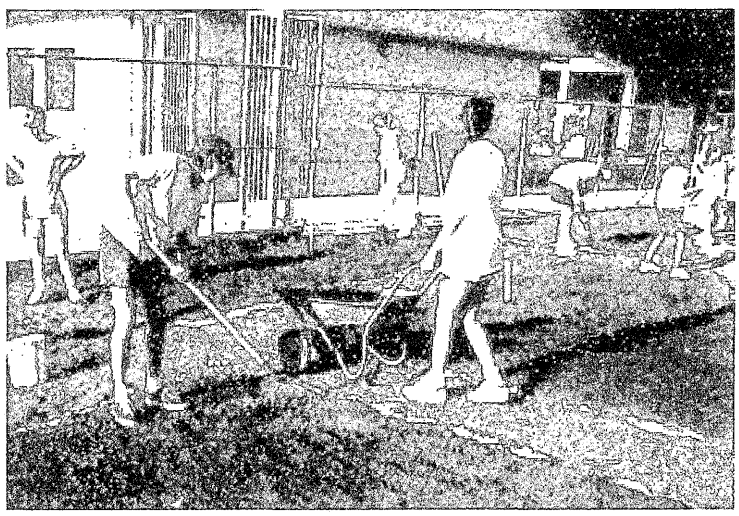
This may also be the first opportunity some of the teachers and volunteers have had to work in a garden. The printed notices should include; the date, time, tools to bring, and what to wear. What to bring and what to wear may seem like unnecessary information, however, many would-be gardeners will be learning "on the job." The steering committee should assume that all the participants are new to gardening. Let everyone know they should wear sturdy shoes, gloves, and hats. Tell them to bring shovels, rakes, hoes, and other tools as needed.

Plan for restrooms and refreshments. Everybody works better when they are comfortable.

If you are working after school hours, the restrooms may be locked. Make arrangements to have them open for the work crew. Also, have water available. It can be bottled water, drinking fountains, or water jugs and cups, but be sure to have plenty of water for the workers.

In addition to water and restrooms, extras like coffee and donuts go a long way toward keeping garden volunteers happy. The PTA may agree to provide treats for the volunteers. However, at least in the early stages of garden development, the money for refreshments will most likely come from the pockets (or purses) of the steering committee. Providing snacks is optional, but it will enhance the volunteer's perception of their work experience.

When planning a garden workday, know what needs to be done that day. In the early stages of the garden development limit the activities scheduled for each work day. Stick to one or two goals that can be accomplished in the time allotted. For example, if the garden area is large plan on clearing the site (of weeds and



debris) one day, and cultivating or rototilling on another. Stick to a time schedule so volunteers can plan their day.

After the garden plots are prepared, keep the enthusiasm going with occasional short meetings to inform gardening teachers of any news or information related to school gardens. Check with teachers to see what kind of help or support they may need. Teachers new to gardening will appreciate basic gardening information, while others may need ideas to tie gardening to the curriculum (see the sections, Vegetables for All Seasons, and Resources).

As the gardens become established the weeds may grow faster than the vegetables. Look to the community for volunteers that would be interested in weeding and watering the garden plots. Also, if the school is on a traditional schedule, the vegetable garden is becoming most productive just as school is ending. Try to make arrangements with families living near the school to water in exchange for the harvest. The mature garden will be there to inspire gardening students and teachers returning in the fall.

Garden Basics

Sun. Most plants need at least six hours of direct sun. A full day of sunlight is best. Check the site during different seasons. The angle of the sun is very different mid-winter and some areas may not get a full day of sunshine in the winter.

Soil. Almost every garden spot will benefit from soil amendments like (organic) fertilizer and compost. Test kits are available at home centers and nurseries to determine the specific needs of a garden soil. Get the students involved in the testing process. They will learn that soil is an active eco-system. They will also discover that the way we treat the soil influences the fertility and therefore the productivity of the garden.

Water. The garden has to be near a water source. Carrying buckets or pails of water to the garden may seem acceptable in the beginning, but when the weather heats up and the garden is thirsty, sprinkling cans will not do the job. Make sure a watering hose can reach the farthest corners of the garden.

Pathways. Garden paths should be at least three to four feet wide. There should be enough room to maneuver a wheelbarrow, or a wheelchair. If the garden is very large, make the path even wider. The walkway should be covered with a porous material that provides a firm footing, yet allows the water to drain. Small wood chips, walk-on mulch, or decomposed granite are all good path covers. The paths should make garden access easier and encourage visitors to walk through the gardens.

Plants. Before the theme of the garden is established and students know the plants they want to grow, stop and consider the time of year. Some schools follow a traditional schedule, while other schools are in session year-round. Plants have their own schedules as well and they may not coincide with the garden that was planned. There are plants for every season, just keep the calender in mind when choosing a garden theme. See the section, Vegetables for All Seasons.

When planting seeds, refer to the seed packet for information on planting times, depth and spacing. Additionally, some seeds may be started in the classroom and then moved outdoors, while others (like carrots and radishes) do not like to be transplanted.

Nurseries carry small seedlings in six packs (sometimes called "pony packs"). These small plants are stocked according to the season. If a plant is available at the nursery or garden center, it is probably the right season to put it in the garden.

Grow Organically. This seems like an unnecessary bit of advice given the environmental treatise that preceded this chapter. Never-the-less, make sure that everyone participating in the garden program understands they may not use herbicides or pesticides in or around the garden. Teach the students to pick up snails and slugs. Use streams of water, insecticidal soaps and encourage beneficial insects to keep garden pests in check. Its safer for the children, and better for the earth.

Laying Out the Vegetable Garden

New gardeners often design their gardens in the traditional way, planting in rows, with watering furrows in between each row. There are some advantages to this layout when gardening with children. The rows can be spaced far enough apart so the students can move easily through the garden, walking in the furrows. However, this design takes a lot of space.

"Square foot" gardening is a more intensive planting method with a greater yield per square foot of garden. This approach eliminates the rows and furrows by breaking the garden into one foot square blocks. Plants grow in very close proximity. Planning is more critical in square foot gardening so that mature vegetables have room to grow. The square foot gardening technique is appropriate for school gardens, especially when space is a consideration.

When designing a garden for children, remember they need to be able to get to the plants. Break large garden plots into rectangles, no larger than 4 foot across. This allows students to work from either side without stepping on the plants.

Raised beds are an excellent way to employ the square food gardening method. Made of lumber or bricks, beds

should be 24 to 28 inches high, providing easy access for all children, including students in wheelchairs. Remember to make paths between the beds (raised or in the ground) wide enough for wheelchairs, and wheelbarrows to pass through.

When building raised beds, do not use treated wood such as railroad ties for vegetable gardens. The chemicals can leach out into the soil and be taken up by the plants. The raised garden beds should also not be wider than 4 foot across. They can be any length determined by the space and the lumber.

A garden design gaining in popularity is the potager, which is French for "kitchen garden." The potager mixes flowers with vegetables and fruit in an informal "anything goes" kind of style. This garden maximizes the space, is beautiful and practical.

Containers are yet another option to create a garden on the school grounds. Barrels, large pots, either terra cotta or the new recycled plastic pots, old wheelbarrows, even tires stacked together can all be filled with soil and become the basis for a beautiful container garden. Keep in mind that container gardens will require more frequent watering.

The final garden design will depend on the school site, the space available, and the number of students and teachers participating in the garden program. If the garden space is very large, it may include several garden styles. Or, the garden might be dedicated to one particular theme and that will determine the design. Regardless of the circumstances, with a little creativity, a garden can grow anywhere.

Connecting Garden Activities to the Curriculum

The following curricular links are intended as an organizational tool to integrate concepts and facts across academic disciplines. They are meant to provide a context though which to present content matter and to relate subjects in a meaningful way. "Facts are useful only when tied to the larger theoretical questions of the natural world - how it works and how its parts fit together" (California State Department of Education, 1990, p. 27).

The goal is to help teachers include environmental education in an already tight schedule by using the school garden as the vehicle to integrate various topics required at each grade level. This is not offered as a comprehensive environmental education program. Rather, it acknowledges the benefits of participation in a gardening program and attempts to make efficient use of limited instructional time by combining several elements of the curriculum.

These links are designed as big concepts to guide teaching strategies, not as individual lesson plans. This allows teachers to incorporate the ideas into their required curriculums using whatever publisher series their district has chosen.

The instructional connections are aligned with the state frameworks in order to be relevant in each district.

These curriculum links are offered as a small sample of the unlimited opportunities to integrate subjects. The purpose is to stimulate additional teaching ideas and strategies for incorporating learning in the garden.

News For Rabbit

by Christhy Phetamphone

I like to hide inside my den
Down beneath the earth,
And listen to the noise worms make
Squirming through the dirt.

I like to hear ants in the hills
Chewing bits of bread,
And dandelion's feathered seeds
Landing overhead.

I love to hear the snail go
Gliding down his slippery trail,
And lizards every time they flail
Their silver-armored -tail.

(Christhy was in the 4th grade when she wrote this. Her teacher, Mrs. Verweil, used the garden to teach a wide range of subjects.)

Kindergarten

Social Studies & History
Including **Language Arts & Math**

Learning to Work Together, Sharing jobs in the garden. Maintaining the garden teaches stewardship.
Learn about the jobs people do including farmers, truck drivers, grocery store workers and others.

Working Together: Exploring, Creating, and Communicating. Share discoveries in the garden, develop vocabulary with garden songs and poems. This is also good for *English Language Learners* and works toward the Language arts benchmarks for *Phonemic Awareness (1.7-1.12), Vocabulary Development (1.17, 1.18),* and *Written and Oral English Language Conventions (1.1).*

Reaching Out to Times Past. Make the connection between people who grew their food and fiber long ago.
At Thanksgiving go into the garden and see what is left. Tell students that the Pilgrims had to depend on food from the garden, and they learned how to grow many of their vegetables from the Native Americans. Pull dried corn from the garden and discuss how corn was used. Bring in other grains and talk about how they grow and how they are used in food products. If possible, bring in a stone grinder and let children take turns grinding the corn. Do a whole group interactive writing session on how to make corn bread. This models both *reading and writing,* working toward those benchmarks. Follow up by making cornbread. Model measurements and measuring tools such as table spoons and cups. This activity incorporates *math (Number Sense 1.1-1.3, Measurement, 1.1)* and *science (matter changes)* benchmarks.
drawing activity. Have students describe *(Vocabulary Development, 1.17, 1.18)* the cotton boll, and draw *(science observation,* and *art)* it.

Science
Including **Language Arts & Math**

Physical Science

1.a. Describe properties of plants, vegetables, fruits, soil, and tools used in farming and gardening *(Vocabulary Development, 1.17, 1.18)*.

1.b. Properties of water can be observed and predicted as you water the garden.

1.c. Evaporation of water can be observed.

Life Science

2.a. Observe and describe the differences in the appearance and behavior of animals in the garden such as insects, worms, spiders, bugs, slugs, birds, and a host of other critters.

2.a. Observe and describe the differences in the appearance and behavior of different types of plants such as vegetables, fruits, trees and flowers. Look at different fruits and vegetables with the magnifying glass. Are there similarities? Collect leaves from several varieties of trees and make crayon rubbings. These activities enhance observation skills.

2.b. Understand that stories sometimes give plants attributes they do not really have *(Reading Comprehension, 2.3, Literary Response* and *Analysis, 3.1)*.

2.c. Observe and identify the major structures of plants (roots, stems, leaves, flowers, fruits, seeds). Grow sunflowers, draw the sunflower and label the parts *(Writing 1.0-1.4)*.Ask students if they know where their T-shirts come from. *Write* their answers on the chalk board (modeling *Concepts About Print, 1.2,1.3)*.
Pass out cotton bolls and let students look at the bolls through a magnifying glass. Ask what they see? Can they feel the seeds? Show them how the fibers are combed and twisted into yarn to make T-shirts and other clothing.
Have them feel their shirts and feel the cotton. Pass out cotton seeds and plant a "T-shirt" garden. If this

activity takes place toward the end of the year, follow up with a *writing and drawing activity. (Writing Strategies, 1.0-1.4)*.

2.c. Observe and identify the major structures of animals that inhabit a garden. Have students look at worms under a magnifying glass. Identify the parts. Measure the worms. Watch as they move from the light to the shade. Talk about the worms beneficial presence in the garden. Ask each student to draw and write about their worm, including the measurement *(Writing, 1.0-1.4, Written Conventions, 1.1, 1.2, Vocabulary and Concept Development, 1.17, 1.18, Math, Measurement, 1.0, 1.1)*.

Earth Science

3.b. Observe changes in the weather and how that affects what farmers grow, what insects are in the garden, how much watering needs to be done, which flowers are blooming, what the birds are doing, etc. Use the garden to teach concepts of time, such as seasons *(Math, Measurement and Geometry, 1.2)*. Also, use the garden to demonstrate how we use our five senses.

3.c. Identify the resources in the garden such as water, soil, air, and discuss their conservation. Songs and poems reinforce the concepts and help with language development *(Reading, Phonemic Awareness, 1.9, 1.10, Vocabulary and Concept Development, 1.17, 1.18)*.

First Grade

Social Studies & History
Including **Language Arts & Math**

Developing Social Skills and Responsibilities. Garden maintenance help to develop cooperation, taking turns, responsibility and stewardship.

Expanding Children's Geographic and Economic Worlds. People's lives (including food and clothing) are determined by the physical environment where they live. How does the environment affect what we grow in the garden? What do we eat or wear that comes from other areas? How do crops get from the field to the table? *(Reading Comprehension, 2.6)*

Developing Awareness of Cultural Diversity, Now and Long Ago. Learn about the foods of other cultures. Grow some of those fruits or vegetables in the garden. Learn some recipes and make a meal from another culture *(Reading Comprehension, 2.3, Measurement and Geometry, 1.0, 1.1).*

Science
Including **Language Arts & Math**

Physical Science

1.a. Understand that water is a liquid, soil is a solid, and the air in the garden is a gas.

Life Science

2.a. Understand that different plants grow in different environments. This can relate back to cultural awareness from *Social Studies*, different environments shape our lives, dictate the surrounding vegetation.

2.a. Animals have external features that enable them to thrive in different environments. In the garden environment every creature has mechanisms for eating, defending, surviving.

2.b. Animals and plants need water. Students can experiment by withholding water from some plants, and over watering others.

2.b. Animals need food. Put up a bird feeder and keep graph the variety of birds when they come to feed *(Statistics, Data Analysis and Probability, 1.0-1.2)*.

2.b. Plants need light. Plant some seeds in the garden in full sun, plant others in the classroom and keep the covered. What happens? Record observations and measurements *(Statistics, Data Analysis and Probability, 1.0-1.2)*.

2.c. Animals eat plants or other animals for food. Release ladybugs or green lacewings into the garden to prey upon aphids and other pests. Have students write what they think will happen. Observe the beneficial insects in the garden and write what did happen *(Reading, Vocabulary Development, 1.17, Writing Strategies, 1.0-1.3, Writing Applications, 2.1, 2.2)*.

2.c. Animals will use plants or other animals for shelter. A butterfly garden offers good examples of how the butterfly depends on different plants during each phase of its development. Observe and record the life-cycle of a butterfly. *(Reading, Vocabulary Development, 1.17, Reading Comprehension, 2.2, 2.3, 2.5, 2.6, 2.7, Writing Strategies, 1.0-1.3, Writing Applications, 2.0-2.2)*.

2.e. Plants get water and nutrients through their roots and leaves. Student can learn how plant take in water by putting a celery stalk in colored water and watching the color move up through the veins. *(Reading Comprehension, 2.6, Speaking Applications,2.4)*.

Earth Science

3.a. Record the weather in the garden. Make a graph to chart sunny, rainy or windy days. Use a rain gauge to measure the rain. Keep track of the temperature in a season using a thermometer. *(Number Sense, 1.0, 1.1, Statistics, Data Analysis, and Probability, 1.0-1.2)*.

3.b. Understand predictable trends in the seasonal weather. Observe the changes of the seasons in the garden. Plant appropriate plants in season, and discuss why those plants are suited to the season.

3.c. Understand the sun warms the air, land and water. Make sure the garden is where it will receive at least 6 hours of sunlight a day.

Second Grade

Social Studies & History
Including **Language Arts & Math**

People Who Supply Our Needs. Emphasis is on people who supply our food. Look at farmers here and in other countries. Identify the different variety of foods, where they come from and how they grow. How does climate affect the crops a farmer can grow? What kinds of food can be grown in the school garden based on the local climate? What are California's top ten commodities? Can they be grown in the school garden? *(Math, Number Sense, 1.0, 1.1, Statistics, Data Analysis, and Probability 1.0-1.4, Reading Comprehension 2.0-2.8).*

Our Parents, Grandparents, and Ancestors from Long Ago. Compare and contrast the lives of parents and grandparents. Did they grow and prepare their own food? Did grandparents or great grandparents can or preserve their own food? *(Speaking applications 2.0-2.2).*

People from Many Cultures, Now and Long Ago. George Washington Carver is one of the many extraordinary people who have made a difference in our lives. Grow peanuts and tie it to the unit on Carver. *(Science, investigation and experimentation).*

Science
Including **Language Arts & Math**

Physical Science

1.d. Understand that tools and machines are used to apply force (pushing and pulling) to make things move. In connection with Social Studies and people who supply our needs, discuss the use of large farming machines such as harvesters, plows, seeders, and mowers. *(Math can be applied when learning that each farmer feeds x amount of people with the aid of machinery).*

Life Science

2.a. Understand that organisms reproduce offspring of their own kind and they will resemble their parents and each other. This will become evident in a natural garden environment watching insects reproduce. Students will also recognize that plants make seeds which will produce the same kind of plant.

2.b. Understand the sequential stages of life cycles of animals. Many insects go through their life cycles in a garden. Plant flowers that attract butterflies to observe their life cycle. Students can research the butterflies that live in the area. They should also look for plants that are host plants for the caterpillar, and flowers that feed the butterflies *(Reading Comprehension 2.0-2.8, Writing Strategies, Research, 1.3)*.

2.c. Many characteristics of an organism are inherited from the parents and some are influenced by the environment. Observe characteristics of insects in the garden and try to determine why they have developed these physical traits (defense, camouflage, etc). This can be tied back to the *social studies* unit on "Parents, Grandparents and Ancestors" with discussions on how we share the physical characteristics of our family.

2.d. Understand the variation among individuals of one kind within a population. Observe garden insects with a magnifying glass to study the shape and coloration.

2.e. Understand that the germination, growth, and development of plants can be affected by light, gravity, touch, or environmental stress. Experiment with plants in the garden by subjecting different plants to various stressors (too much handling, not enough light, etc). Have students chart the results and then explain what they think happened *(Math, Statistics, Data Analysis, and Probability, 1.0-1.4, Listening and Speaking, 1.5-1.9, 2.2)*.

2.f. Understand that flowers and fruits are associated with reproduction in plants. Use flowers and fruits from the garden to study the reproductive parts with a magnifying glass. Discuss the importance of pollinators to farmers and small gardeners.

Understand the need to limit the use of pesticides because they will also kill beneficial insects. Students will draw a flower and label the parts *(Reading Comprehension, 2.1, 2.5, 2.7, Writing, 1.0-1.3)*.

Earth Science

3.a. & b. Understand that different kinds of rocks are composed of assorted combinations of minerals. Look for rocks in the garden. Discuss their origin, and properties.

3.c. The ingredients (living and non-living) in the soil support the growth of many different types of plants. Certain soil structures are better for plant life. Analyze the contents in various soil types: sand, clay, compost, garden soil. Chart the results *(Math, Number Sense, 2.0, 4.0, Statistics 1.0-1.4, Mathematic Reasoning,1.0-2.2)* Also, grow potatoes, carrots, or radishes in different kinds of soil and chart the difference.

3.e. Understand that plants and soils provide many resources including food and building materials. Make a list of what students ate for lunch. Trace each item back to the soil. For example; milk>cow>alfalfa>soil. Grow cotton to show students where their jeans and T-shirts come from. Tie cotton production back to the *social studies* units on "People Who Supply Our Needs."

Third Grade

Social Studies & History
Including **Language Arts & Math**

Continuity and Change. Students learn about American Indian nations in their region. Create a native plant garden. Grow the plants the American Indians grew, including, corn, beans, squashes and gourds, tomatoes and potatoes. *(Reading Comprehension, 2.0-2.6, Writing 2.2, Listening & Speaking, 1.0-1.3, 1.5-1.8, 2.1, 2.3).*

Our Local History. Research the local history including farming development in the region. Investigate the top agricultural products in the area (past and present). *(Math, Number Sense, 2.0-2.2, 2.7,2.8, Algebra, 2.0, 2.1, Reasoning, 1.0-1.2, 2.0-2.6).*

Science
Including **Language Arts & Math**

Physical Science

1.a.&b. Understand that plants convert the sun's energy into food we can eat and fuel we can burn. Tie back to the *social studies* unit on American Indians.

Life Science

3.a. Understand that plants and animals have structures that serve different functions in growth, reproduction and survival. Let some of the plants in the garden go to seed and study the seed formation. Look at plant and insect adaptations. Try and analyze the purpose of some plant characteristics (sticky, thorny, etc.).

3.d. Know that when the environment changes, some plants and animals survive and reproduce, and others die or move to new locations. Grow dill and fennel to attract the swallowtail butterfly whose habitat is disappearing due to construction.

Research other changes in plant and animal life in the local area. *(Reading, Word Analysis, 1.0-1.2, 1.6-1.7, Comprehension 2.0-2.6, Writing 2.0-2.2, also ties into social studies local economy, agriculture now and long ago).*

Earth Science

4.e. Understand that the position of the sun in the sky changes during the course of the day and form season to season. Use shadows from tall plants to measure and mark the position of the sun as it crosses the sky. Make daily and seasonal observations. *(Math, Statistics, 1.0-1.4).*

Fourth Grade

Social Studies
Including **Language Arts & Math**

California: A Changing State. Students will learn to identify the major regions of the state including the geographical features and varied land use. Identify the major agricultural areas. Grow some of the top ten commodities. *(Number Sense, 1.0, 2.0, Statistics, Data Analysis, and Probability, 1.0-1.3)*

Pre-Columbian Societies, Spanish Missions. Learn the major nations of California Indians, their activities and customs, use of land and sea resources. Spanish exploration and the mission settlements influenced the Indians cultivation and irrigation of crops. Missionaries also brought new crops to the region. In the garden, plant foods that were grown on missions, corn, beans squash, grapes, wheat, etc. *(Reading Comprehension, 2.0-2.6, Writing Strategies, 1.0-1.9).*

Gold Rush. Discuss how immigration to California brought great diversity to the state. Immigrants made many contributions in the development of the state (and nation) including Chinese immigrants who helped build the transcontinental railroad of the transcontinental railroad. Grow crops from the Chinese gardens such as celery, cabbage, bok choy, etc.

Trace the evolution of California's water system. Find the connection between water rights, agriculture, and the California voter initiative system. *(Writing, 1.0-1.9, 2.0-2.4).*

Science
Including **Language Arts & Math**

Life Science

2.a. Understand that plants are the primary source of matter and energy entering most food chains. When cattle eat grains and alfalfa, they are the first order consumers. When we eat the beef, we become the second order consumers.

2.b. Understand the relationships in an ecosystem. Producers and consumers are related in food chains and webs, and they may compete with each other for resources. The garden provides good examples of interdependence between insects and plants. (Ants herd aphids for their honeydew, ladybugs eat the aphids, and so on.)

2.c. Learn how decomposers recycle matter from dead plants and animals by building a compost bin in the garden. *(Math, Measurement & Geometry, 1.0-1.4, 3.5, 3.6, Reasoning, 1.0-1.2, 3.0-3.3).*

3.a Know that ecosystems can be characterized in terms of their living and non living components. The living elements depend on one another and their environment for their survival. Describe the ecosystem in the garden. *(Writing 1.0-1.3, 2.0, 2.1).*

3.b. For any particular environment, some kinds of plants and animals survive well and some do not. Relate this information back to the *social studies* unit on the geographic profile of the state. Why are some regions more suited to agricultural development?

3.c. Plants depend on animals for pollination and seed dispersal. Talk about the importance of limiting the use of pesticides which can also kill the bees. Look at different seeds and how they have evolved to aid in dispersal. (Sticky, tendrils, "wings," etc.).

3.d. Know that many microorganisms are beneficial. Study the microscopic organisms at work in the compost bins.

Earth Science

4.a. Know the different types of rocks (igneous, sedimentary, metamorphic) and explore the garden soil for examples of each type.

5.a. The Earth changes slowly due to erosion, or sometimes rapidly due to landslide. Find examples of erosion in the garden.

5.b. Natural processes such as the growth of roots, break big rocks into smaller pieces. Look at the roots of large trees and see how they are affecting the cement or ground above them.

5.c. Moving water erodes the land, reshaping the topography and taking soil away. Soil erosion is a serious problem in agriculture. Experiment with the garden hose running slow, and then fast, on bare ground and over plants.

Fifth Grade

Social Studies & History
Including **Language Arts & Math**

United States History and Geography: Making a New Nation.
Building on what students learned about American Indians in the fourth grade, study the major settlements in the desert Southwest, Pacific Northwest, the Great Plains and east of the Mississippi. Indians came to the aid of the early Pilgrims and taught them how to grow corn and other crops indigenous to the area. Plant the crops of the early settlers. Talk about how the pilgrims had to survive on what they could grow or hunt. How did the location of the first colony influence what they could grow? *(Reading Comprehension 2.0-2.5, Writing 2.3).*

Science
Including **Language Arts & Math**

Physical Science

1.g. Understand the properties of some solid, liquid, and gaseous substances such as sugar, water, oxygen, and carbon dioxide. Teach the lesson of photosynthesis as an example of these properties. Have students taste the sugar produced by plants in the garden (snow peas, sweet corn, and strawberries are good examples).

Life Science

2.a.&e. Know that many multicellular organisms have specialized structures to support the transport of materials. Study cross sections of plants (from the garden) under a microscope to see their transport structures. Put a stalk of celery in colored water to demonstrate the vascular action.

2.f. Know that plants use carbon dioxide and energy from sunlight to build molecules of sugar and release oxygen. Tie these concepts back to *physical science, 1.g.*

2.g. Know that plants and animals break down sugar to obtain energy, forming carbon dioxide and water (transpiration and respiration). Put a bag over a plant in the garden (be careful not to "cook" the plant). Observe the water droplets condensed inside the bag. Do some research to find out how much water a mature tree transpires. What inferences can be made from this information? *(Math, Number Sense, 2.0-2.3, Algebra, 1.1, Reasoning, 1.0, 1.1, 2.0-2.4, 3.0-3.3).*

Earth Science

3.d. Know that the amount of water on Earth is limited and its availability can be extended through recycling and decreased use. Teach water conservation in the garden by not watering in the hear of the day (evaporation), using mulch on the soil to decrease evaporation, and by using drip irrigation. Xeriscape gardens are a good way to demonstrate water conservation by using drought tolerant plants. Research plants that require little water and use that information to create a water-wise garden. This can also tie back to the *social studies* unit by including plants that were used by the American Indians. *(Reading Comprehension 2.0-2.4, Writing, Research 1.3, 1.4).*

3.e Know the origin of local water. Visit the water company that supplies water to the garden. Learn how to read the school water meter and graph the amount of water used during the year. *(Math, Algebra 1.0, 1.1, Statistics, Data & Analysis, 1.0-1.2).*

4.b.&d. Know the role of the water cycle in weather. Measure and graph rain fall in the garden. Predict the local weather. Observe changes in the in the plants, and insects in the garden as the seasons change. *(Math, Statistics, Data & Analysis, 1.0-1.4, Reasoning, 1.0-1.2, 2.3, 3.3).*

Sixth Grade

Social Studies & History
Including **Language Arts**

Early Humankind and the Development of Human Societies, depended on the evolution of irrigation and agriculture. Grow barley (the first domesticated grain). Women were the first seed and plant gatherers. Agriculture grew with the invention of the wheel and plow. Grow the foods of ancient civilizations; artichokes, grains (wheat, oats, barley, rice), carrots, peas, cabbage, eggplant, apples, grapes, pears, peaches. Have students research *(Reading 2.3, 2.4)* the cultures to find out what they grew, then *write(2.3, 2.4)* the results of their search. Additional research; How did agriculture influence the development of the culture? *(Reading 2.3, 2.4, Writing 1.1-1.5).*

Science
Including **Math & Language Arts**

Life Science
Ecology

5.a. The exchange of energy and nutrients in an ecosystem can be observed and understood by investigations with photosynthesis and food webs in the garden. (The equation for photosynthesis, *Algebra, 1.1*)

5.b. The transference of matter from one organism to others in the food web, and between organisms and the physical environment can be studied and observed in various situations in the garden such as the compost bin and the worm bins. Have the class make a worm bin, or start a compost pile. Determine the amount of organic waste from the school cafeteria in one day. Use that number as the basis for some calculations to learn about recycling waste. How much can the worms consume? How many worms would be needed to take care of all the organic waste from the cafeteria each week? In a month? For the whole year? *(Number Sense 1.1-1.5, Algebra 1.1, 1.2, 2.1).*

5.c. The garden is a dynamic ecosystem in which organisms can be categorized by the functions they serve such as decomposers, pollinators, predators, beneficial insects, pests, and others.

5.d. Students can investigate the existence of different kinds of organisms playing similar ecological roles in similar biomes. The garden can be their base for comparisons. *(Research, Writing, 1.4, 1.5, 2.3)*.

5.e. Use the garden as an ecosystem for investigative studies on its ability to support life. Study variables such as light, water, temperature and soil composition. *(Math)*.

6.b. Understand renewable and nonrenewable resources. Students can observe and classify resources in the garden (air, soil, rocks, water, plants, wildlife, etc). Students can learn about the effects of soil erosion, and conservation practices. Research and write about ways to conserve natural resources *(Research, Writing,1.1-1.6, 2.2-2.5)*.

Funding the Garden

For most garden projects it is a good idea to start small and work with what is on hand. Borrow tools, scavenge seeds and garden materials and look for donations from parents, other teachers, and community members.

As the garden grows, interest will grow too. More teachers will want to join the garden project and volunteers will start turning up. At this time some more significant funds will be needed to expand the garden. This is also the time when the steering committee will need to guide the garden development and the related expenses.

Develop a "wish list" of materials and supplies needed for the garden project. If a donor pops up unexpectedly, having a list allows them the opportunity to choose what they would like to provide.

Make sure parents know about the garden. They are often a good source for volunteer time and material donations. Look to the surrounding community for businesses that are willing to furnish garden supplies.

Check with the school budget to see if there is money available for the garden. Talk to the PTA about donations, volunteers, or assistance in fund raising efforts. Consider plant sales, can drives, or sales of garden crafts to bring

in revenue for the garden. Ideas for fund raising events are only limited to the imagination, and the people power available to make it happen. Additionally, garden benefits involve other people in the project and the community is inspired working toward a common goal.

Grants are another opportunity for garden money and materials. Research grants available from foundations and organizations that support school and community garden development, and environmental or nutritional educational initiatives. Get help and advice from an expert on the staff or at the district level when writing for grants. Always follow the application rules and guidelines contained in the grant. Give the foundation everything they ask for, the first time. Show appreciation when your organization receives a grant. When writing a grant or approaching potential donors, the National Gardening Association advises the use of some of these phrases:

- I've reached . . .
- Hands-on learning
- Interdisciplinary
- Encourage commitment and follow-up from kids
- Experiential
- Integrated, inquiry-based learning
- Garden would benefit the school and community

- Connect today's pressing environmental issues
- Enhance current curriculum
- Conservation techniques
- Responsibility in ecological structure
- Give children and community a sense of caring and giving back
- Make children good stewards of the earth (National Gardening Association, 2000)

Some grant opportunities include:

America the Beautiful Funds
1511 K Street, N.W. Suite 611
Washington, DC 20005
(202)638-1649
National nonprofit association assists community programs and projects with free seeds for gardens and education programs.

California Adolescent Nutrition and Fitness Program (CANFIT)
(510)934-9102
www.canfit.org
Provides fitness and nutrition grants to organizations serving low income African-American, Latino,

Asian/Pacific Islander and American Indian youth.

California Department of Education
Nutrition Education and Training Program
Garden-Enhanced Nutrition Education Grant
Grants are to support and encourage nutrition education in school garden programs.
(916)322-4792

California Fertilizer Foundation
1700 I Street, Suite 130
Sacramento, CA 95814
(916)441-1584
Mini-grants.

California Integrated Waste Management Board
(916)255-2385
www.ciwmb.ca.gov
Local boards may help fund programs that include recycling, composting or vermiculture (worms).

Environmental Education Grant Program

Office of Environmental Education

California Department of Education

721 Capitol Mall

Sacramento, CA 95814

(916)322-9503

Environmental Protection Agency-Environmental Education Grants

Office of Environmental Education Grants

401 M Street, S.W., Room 368

Washington, DC 20460

(202)260-3335/0255

Funds practices or projects that provide environmental education.

Lily Ponds for Youth Grant Program

Lily Ponds Water Gardens

P.O. Box 10

Buckeystown, MD 21717

(301)874-5503

Provides matching funds to develop aquatic environments.

Youth Garden Grants Program

National Gardening Association

180 Flynn Avenue

Burlington, VT 05401

www.garden.org

Distributes tools, seeds and other garden supplies.

Western Municipal Water District

(909)780-4170

Mini grants up to $500 for projects that demonstrate water conservation. (Southern California only, specified regions).

This list is just a sampling of the many potential funding sources for the school garden. The Internet is another good resource to find garden related grants.

Garden Themes

Gardens provide hands-on learning opportunities for students to apply what they have learned in other subject areas. They are beautiful dynamic settings in which to integrate all aspects of the curriculum, including science, math, language arts and environmental studies. Developing the garden as a thematic unit is one way to instantly incorporate gardening activities into the state and district benchmarks and standards.

> For example, to gather background information to help develop a theme garden, students will read reference materials to research information, and then write their plans. In analyzing garden data, students will be applying math skills. In studying the effects of erosion on soil, there are opportunities to integrate social studies and science. Sitting quietly in the garden and drawing the plants or animals that they see, students will be applying their drawing skills to natural history observations (Life Lab Science Program, 1998, p.12).

Choosing a theme that ties in with social studies, or history units at each grade level strengthens the relationship between garden activities and teaching to the benchmarks.

Some examples of garden themes:

History Gardens. Pick a time in history and investigate what kinds of gardens were grown at that time. (Keep in mind the local of your garden. Do not try to

duplicate gardens from distinctly different climates). Some possibilities include a Victorian cottage garden, a garden from Colonial America, or a Native American garden.

Butterfly Gardens. Investigate the butterflies that live in your area and learn about the plants that feed and sustain them. Butterflies need host plants, the vegetation that the caterpillars feed on, and nectar plants to feed on after they emerge from the chrysalis.

Ecosystem Gardens. Grow a prairie garden, xeriscape garden, or a habitat garden using plants native to the area.

Heritage Gardens. Try collecting and growing heirloom vegetables. Use this as a springboard to investigate the importance of preserving biodiversity. Or consider your local heritage and research the agricultural crops that were a part of the region's history.

Nutrition Gardens. Use the school garden to help children learn more about where their food comes from. Developing the nutrition them further, several schools have created "Pizza Gardens." They grow the ingredients to make a pizza, including tomatoes, herbs, peppers, and sometimes even wheat (though it would be difficult to grow enough to use, it makes the point). Students can even put together a classroom cook book of recipes using the crops from the garden.

Sunflower Gardens. Explore the many varieties of sunflowers available and learn the different ways we use the seeds.

Secret Gardens. Use plants to create a "fort" or hideaway. Poles tied together and then planted with climbing beans can form a "teepee." Tall sunflowers can make a garden "wall." Plant the sunflowers around the perimeter of the garden to create a walled in "secret garden."

Literature can also inspire a garden theme. PBS recently featured a Beatrix Potter garden. The owner designed the garden to include the herbs and vegetables mentioned in Beatrix Potter's books. Of course, school garden plots do not have to be edible. Some students may prefer to develop a theme around a color, for example, different varieties of yellow flowers. Garden theme possibilities are endless. Consider the mainstays of the grade level curriculum. Think about ways to expand on those topics. Remember to include the students, they may have some great ideas.

Also, once the theme is chosen, ask the class to name their garden plot. This encourages class participation and fosters identity with the garden.

An important consideration in choosing a garden theme is the time of year the class will be planting the garden. Most of the plants grown in school gardens are seasonal. This may influence the garden motif because the selection of vegetables and flowers will be dictated by the time of year. Gardeners in mild climates are able to grow both a summer and a winter garden. For more information on growing vegetables in season the section, Vegetables For All Seasons.

Vegetables For All Seasons

In mild climates, gardeners can enjoy both a summer and a winter garden. Still, even in temperate locals, the season dictates the plant selection. The summer garden is actually planted in spring (and sometimes late winter). These plants come to maturity in the late spring on through the summer months. They will start to fade around August or September. Winter gardens are planted in late summer, and early fall. These plants like the warm start, but prefer cooler weather in maturity.

Some of the plants that can be grown as a winter crop are:

- Beets
- Bok Choy
- Broccoli
- Brussel sprouts
- Cabbage
- Carrots
- Cauliflower
- Celery
- Chives
- Kohlrabi
- Lettuce
- Parsley
- Peas (both shelling and edible pod peas)
- Radishes
- Spinach
- Swiss Chard
- Turnips

This is but a partial list of the vegetables that can be grown in the fall and winter. Many flowers also do well at this time of year. Most of the flowers that bloom in the spring need to be planted in the fall and winter. This includes flowers from seed as well as flowers from bulbs, and rhizomes.

Vegetables and fruits for the spring and summer garden include:

- Beans (all kinds of beans)
- Beets
- Carrots
- Corn
- Cucumbers
- Gourds (not edible, but fun to grow)
- Herbs (including basil, marjoram, oregano, chives, and many others)
- Lettuce
- Melons
- Onions
- Potatoes
- Peppers
- Pumpkins
- Strawberries
- Squash (all kinds of squash)
- Tomatoes
- Tomatillos

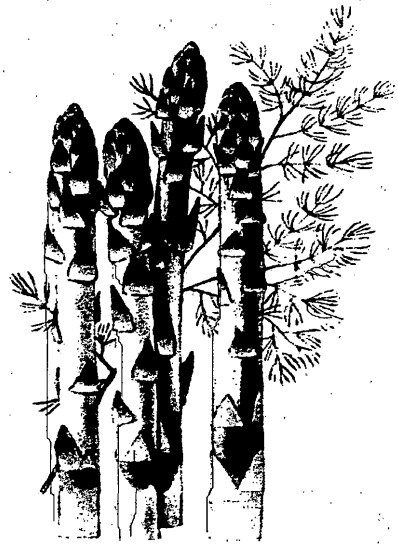
Again, this is just a sampling of plants for the summer garden. As students and teachers become more experienced gardeners they will find a wide and interesting variety of vegetables and fruits to add to the school garden.

Planting Guide

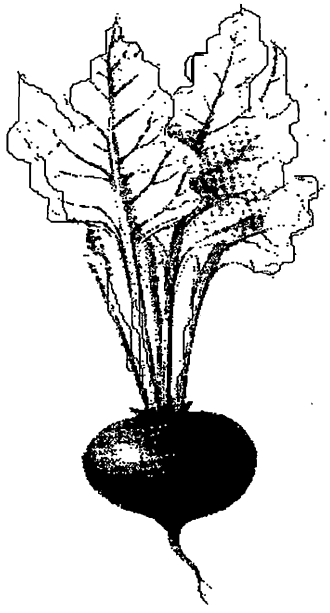
The planting information that follows applies to south-western climates. Check regional guides for planting in other locals. This guide is intended as a primer for teachers interested in planting vegetables (and fruits) in a school garden. For more in-depth information, please refer to the resource list of gardening books and web sites.

Artichoke Perennial, the bud is edible in early summer only. If not picked, the bud becomes an attractive flower which can be dried. Watch for aphids on the foliage. Wash them off with a strong stream of water.

Asparagus Perennial, takes 2-3 years for full production, then can be harvested every spring for 10-15 years. Leave the spears on the plant to make foliage the first year. They manufacture food for the roots. Cut the dry stems back in the fall. In the spring of the second year harvest asparagus spears for 4-6 weeks then allow the foliage to develop. Space plants 4-6 feet apart.



Beans Snap beans, lima beans, and other shelling beans all have similar needs. The are warm weather crops and grow best in full sun. Beans come in pole or bush varieties. Choose the form that best suits the space available. Plant in Spring, 1" deep, 1-3" apart, in rows 2'-3' apart. Beans take 60-90 days to mature.



Beets Beets are grown in the summer. They are delicious cooked or raw, and the baby greens are good in salads. Plant the seeds 1/4" deep, 1" apart. Plant in monthly intervals to insure a continuous harvest. Water frequently in hot weather to keep beets tender.

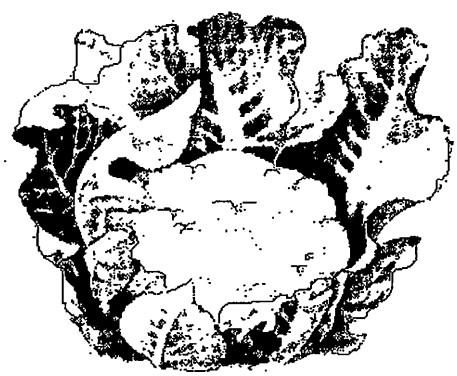
Broccoli Broccoli is a cool season crop and should be planted in late summer, through the winter (in mild climates) and early spring. Seeds can be started indoors and moved outside when the plants 3-5" tall. Watch for aphids. Wash them off with a strong blast of water from the hose.

Cabbage Like broccoli, cabbage is a cool season crop. Cabbage can also be started indoors. Plant seeds ½" deep, in 6 to 8 weeks the small cabbage plants will be ready to set out.

As the plants grow, watch for cabbage worms. Pick them off by hand, or use bacillus thurningiensis (an insect killing microbe, not toxic to humans).

Carrots Carrots can be grown year-round. Grow in full sun, keeping the soil evenly moist. Make sure to prepare the seed bed to a sufficient depth to give the carrots room to grow. Plant seeds 1/4 to ½" deep. Carrots take approximately 70 days to mature.

Cauliflower Cauliflower grows under the same conditions as cabbage and broccoli. Give the plants plenty of space when transplanting the seedlings, at least 18" to 2' between plants. When cauliflower heads begin to form pull the outer leaves over the head and tie with a string. This protects the head from the sun and helps to blanch the cauliflower. Some newer varieties do not need to be blanched and so require less work to cultivate. Cauliflower is also susceptible to aphids and cabbage worms, treat it the same as broccoli and cabbage.



Celery Celery is another cool season vegetable. Like cauliflower, celery requires some additional care to

obtain best results. It also takes patience. Celery takes 4-5 months to mature from seed. As the celery grows, work soil up around the base of the plants to blanch the stalks. Some gardeners blanch the celery for a week before harvesting by blocking the sun with straw, or cardboard. This extra effort is more for esthetic appeal than for flavor.

Corn There is nothing quite like corn fresh from the summer garden. Supermarket corn is a poor substitute for the real thing. The sugar in the corn kernels starts to change to starch as soon as it is picked. Have the water boiling before you pick the corn. Plant corn seeds in full sun, directly in the ground, 1" deep. Corn needs good soil and a bit of space. Plant in rows, but do not plant a single row. Corn depends on the wind for pollination, so it is better to have several short rows than one long row.

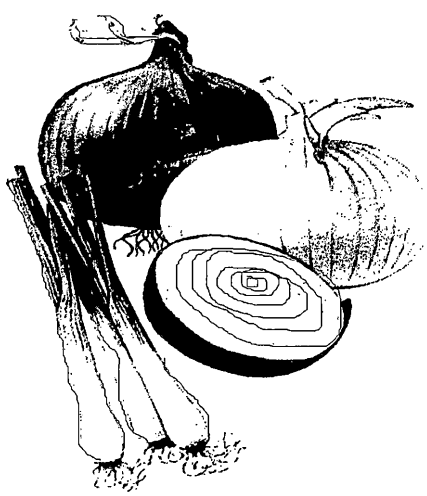
Cucumbers Cucumbers are another summer favorite. Give them full sun and space. Cucumbers can be planted in hills allowing the vines to spread out on the ground, or they can be planted in rows and tied to a trellis. The trellis is a good idea because it saves space and gets the cucumbers off the ground away from insects.

Eggplant This summer vegetable comes in many varieties, shapes and colors. The seeds are slow to germinate,

and for this reason it is often more practical to by seedlings from a nursery. Pick fruit before it loses its shine. Dull fruit is tough and the seeds tend to be bitter. It takes about 70 days (after transplanting the seedlings) for mature fruit.

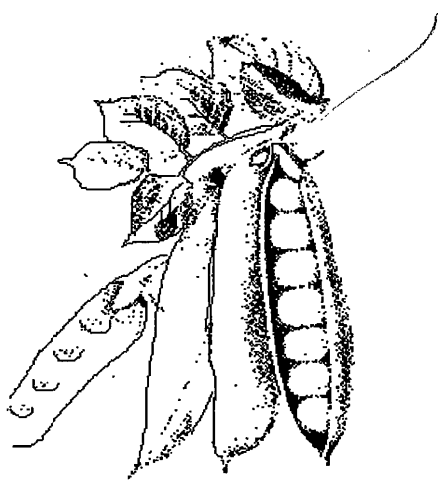
Lettuce Primarily a cool season crop, lettuce can be grown in warmer weather if it is shaded from the afternoon sun. Plant seeds 1/4 to 1/2" deep. Lettuce can be grown in rows or scattered, salad bowl fashion. Loose leaf lettuce can be harvested by taking only the outer leaves, allowing the inner leaves to continue growing.

Melons These summer fruits need 3-4 month of heat, plenty of room to spread and should be planted in full sun. Sow seeds in mounds or hills, planting 1" deep. When the seedlings are 3-4" high, thin to 3 or 4 plants per hill. Water frequently.



Onions Depending on the area, onions can be planted in the spring for harvesting in the late summer and fall, or in the fall for spring picking. Bunching onions can be grown from seed, however bulb onions are usually grown from "sets." Sets are tiny onion bulbs.

Plant seeds about 1/2" deep, sets about 2" deep, spacing them about 4-6" apart. When seeds are about 2" tall thin them to stand 2" apart. Green or bunching onions are ready to pick when they are about the size of a pencil. When the leaves of the bulb onions start to turn yellow, bend them to the side to stop growth. When the leaves turn brown, lift the bulbs from the soil.



Peas Both shelling peas, and edible pod peas (also called Chinese snow pea or sugar pea) are cool weather vegetables. They can be sown in late summer or late winter, early spring. Like beans, peas come in bush and vine types. Moisten the soil thoroughly before planting seeds 2" deep. Do not water again until the seedlings have poked through the surface. Thin seedlings (vine type) to 2" between young plants. Pick peas before the pods turn yellow or shriveled. Edible pods should be picked while the pea pod is still flat.

Peppers The two basic types of peppers, hot and sweet are both grown in the summer. When growing peppers from seed, start them indoors 8-10 weeks ahead of planting time. Young plants can be moved to the garden in early spring.

Grow in full sun, water thoroughly, but do not over water. When picking peppers, cut them from the plant instead of pulling to avoid damaging the plant.

Potatoes Like carrots, potatoes can be grown year-round when planted at the right time - early summer, or late winter. Potatoes are grown from "seed potatoes" which are nothing more than tiny potatoes. Cut the seed potatoes into large chunks, making sure each piece has an "eye" (the small indentation where the vine will sprout). You can use a potato from the grocery store however, it is not recommended because the variety may not be suited to growing in your area. Let the potato chunks dry for four or five days before planting. This reduces the risk of losing the plant to rot. Plant the seed potatoes 4" deep in soil that is not too wet. Because potatoes grow close to the surface avoid deep cultivation around potato plants. When the plants are 8 to 10" tall, pile the soil up around the stems leaving 3 to 4 inches exposed. This protects the potatoes and keeps them from turning green. When flowers appear, "new" or baby potatoes can be harvested. Dig mature potatoes when the vines die down.

Pumpkin Pumpkins are a summer vine related to the squash. They need a lot of space and a long growing time (120 days or longer). Plant seeds in 1" deep, 4-6 seeds in

each hill or mound. When the plants are 4-6" high, cut off all but two vines. From late summer on, remove any new blossoms to channel the plants energies toward the fruit that has already set. To grow exhibition size pumpkins, start with the right seeds, allow only one pumpkin to grow on each vine and water heavily. For school gardens, the mini pumpkins are a nice addition because of the shorter growing times and greater production.

Radishes Radishes can be grown year-round, but they do not like the hottest part of the summer. Sow seeds 1/2" deep, and keep the soil moist. When seedlings are 1 to 2" tall, thin to the strongest plants, 1 to 2 inches apart. Pick the radishes 25 to 30 days after planting (slightly longer in winter).

Spinach Plant spinach in fall, winter, or early spring. Spinach will not tolerate summer heat. Plant 1/2" deep in rich soil. Thin seedlings to 6" between plants, and water frequently. Harvest when the largest leaves are 6 to 8 inches long, or cut like leaf lettuce using the outer leaves and allowing the plant to continue to grow.

Squash There are two main groups of squash, summer squash and winter squash. However, the names are deceiving because both types of squash are grown in the summer. Winter squash has a hard skin, stores well and can last

through the winter, hence the name. Both kinds of squash can be grown using the same techniques as with pumpkins or melons. Summer squash is ready to pick much earlier than winter squash. Harvest summer squash when it is still tender and easily punctured (50-65 days from planting). Let winter squash mature on the vine until the skins are very hard (100 to 120 days from seed to maturity).

Swiss Chard Swiss chard can be grown year-round. Sow seeds directly in the garden, 3/4 to 1" deep. When seedlings are 4-6" tall, thin to 8-10" between plants. The seedlings can be tossed into a salad. Harvest outer leaves regularly leaving the center to continue growing.

Tomatoes The taste of tomatoes fresh from the garden is reason enough to start a garden. There are endless varieties to suit every gardeners needs. Regardless of the variety however, all tomatoes are warm weather plants. Tomatoes can be started from seed indoors, but many gardeners prefer to start with small plants from the nursery. Look for plants that have VFN after their names. This means the plant is resistant to verticillium or fusarium wilt and nematodes (three tomato killers). When transplanting seedlings into the garden, plant the tomato deeper than it was in the original container. Make sure they get full sun and are spaced at least 3' between plants.

Water frequently when the plants are young, less frequently when fruit has set. Tomatoes can just sprawl on the ground, but they do better when staked, grown on a trellis or are held up in some other way. Tomatoes will be ready to harvest in 65 to 85 days, depending on the variety.

Turnips Turnips are grown as a cool season root crop. Like beets, turnips are valued for their tops as well as the roots. Turnips grow rapidly, maturing in 45 to 60 days. Plant 1/4 to 1/2" deep in loose soil, in a sunny location. When the plants are 3" tall thin to leave 2" between plants.

Watermelons Watermelons love the heat and require a longer growing season than most melons. Plant and care for water melons the same as other melons.

Companion Planting

One way to organically manage garden pests is by planting companion herbs along with the vegetables. Many herbs act as a deterrent to certain insects, and they improve the growth and flavor of their companion plant.

A list of herbs, and their companions:

Basil Plant with tomatoes, improves growth and flavor. Repels flies and mosquitoes. Dislikes rue intensely.

Beebalm Also a companion to tomatoes, improves growth and flavor.

Borage Companion to tomatoes, squash and strawberries, improves growth and flavor, deters tomato worm.

Caraway Loosens the soil.

Catnip Deters flea beetle; plant in borders.

Camomile Companion to cabbage and onions; improves growth and flavor.

Chervil Plant with radishes; improves growth and flavor.

Chives Companion to carrots; improves growth and flavor.

Dill Plant with cabbage, improves growth and health of cabbage. Keep away from carrots.

Fennel Plant away from the garden, most plants dislike fennel.

Garlic Companion to roses and raspberries; improves growth and health. Garlic deters Japanese beetle.

Horseradish Deters potato bug. Plant at the corners of the potato patch.

Hyssop Companion to cabbage and grapes, deters cabbage moth. Keep away from radishes.

Lemon Balm
Sprinkle throughout the garden.

Lovage Improves flavor and health of plants if planted here and there.

Marigolds Plant throughout the garden. Marigolds discourages Mexican bean beetles, nematodes and other insects.

Mint Companion to cabbage and tomatoes, improves health and flavor, deters white cabbage moth.

Marjoram Plant here and there in the garden; improves flavors.

Nasturtium
Companion to radishes, cabbage and curcurbits; plant under fruit trees. Deters aphids, squash bugs, striped pumpkin beetles. Improves growth and flavor.

Petunia Protects beans.

Rosemary Plant with cabbage, beans, carrots and sage. Deters cabbage moth, bean beetles and carrot fly.

Rue Plant near roses and raspberries; deters Japanese beetle. Keep it far away from basil

Sage Companion to rosemary, cabbage and carrots, deters cabbage moth and carrot fly. Keep away from cucumbers.

Summer Savory
Plant with beans and onions, improves growth and flavor. Deters bean beetles.

Tarragon Good throughout the garden.

Thyme Also good here and there in the garden. Deters cabbage worm.

Educational Resources for

the School Garden

Books For Gardening With Children

A celebration of culture: A food guide for teachers. (1992). Sacramento, CA: Dairy Council of California.

Barnard, P. (1982). Don't tickle the elephant tree. New York: Simon & Schuster.

Burnie, D. (1989). Discover the world of plants. New York: Alfred A. Knopf.

Carlson, L. (1990). Kids create! Charlotte, VT: Williamson Publishing.

Dempsey, M. W., & Sheehan, A. (Eds.). (1970). How flowers live. New York: Danbury Press.

Dennee, J. (1996). In the three sisters garden. Dubuque, Iowa: Kendall/Hunt Publishing Co.

Ehlert, L. (1991). Red leaf, yellow leaf. Orlando, FL: Harcourt Brace.

Fitzsimons, C. (1995). 50 nature projects for kids. New York: Smithmark Publishers.

Gibson, R. (1999). What shall I grow? New York: Scholastic.

Heller, R. (1983). The reason for a flower. New York: Scholastic.

Ingram, M. (1993). Bottle biology: An idea book for exploring the world through plastic bottles and other recyclable materials. Dubuque, Iowa: Kendall/Hunt Publishing Co.

Jordan, H. J. (1992). How a seed grows. New York: Harper Collins.

Lovejoy, S. (1999). Roots, shoots, buckets & boots. New York: Workman Publishing.

Milord, S. (1989). The kids nature book: 365 indoor/outdoor activities and experiences. Charlotte, VT: Williamson Publishing.

Starcher, A. M. (1995). Good bugs for your garden. New York: Algonquin Books.

Tilgner, L. (1988). Let's grow: 72 gardening adventures with children. Pownal, VT: Storey Communications.

Catalogues, Kits and Pamphlets

Ag Experience. (201) 358-9057 Kits, videos, books and lessons to assist teachers in integrating agriculture in the classroom.

Banana Slug String Band. (888)32-SLUGS. Music about the Earth, with songs for the garden, recycling and conservation.

Carolina Biological Supply Co. (800)334-5551. Science Catalogue.

Cooperative Extension, University of California, Division of Agriculture and Natural Resources. (510)642-2431. Call for a catalog of farm and garden publications.

Cotton's Journey From Seed to You. (209)698-5190, ALACA Co. A field trip in a box. Kit for growing cotton, items may be purchased separately.

Growing Ideas. (800)LETSGRO. A catalogue of teaching tools to help young minds grow.

Resources For Garden Based Education (415)663-9433. Catalog from Gardens for Growing People and Kids in Bloom.

Southern California Native Plants for School Gardens. Betsy Landis, CNPS, 3938 Mandeville Canyon Rd., Los Angeles, CA, 90049.

1999 Teacher Resource Guide. Sacramento, CA: California Foundation for Agriculture in the Classroom.
This is a free guide full of resources on agricultural topics. Web site: www.cfaitc.org

Western Municipal Water District. (909)780-4177. WMWD has several water wise landscaping books and pamphlets as well as curriculum resources for teaching water conservation.

Worms, Worms, Worms, and More Worms: A Guide to Vermicomposting. (916)255-2385. California Integrated Waste Management Board, 8800 Cal Center Dr., Sacramento, CA, 95826.

Curriculum Resources Including Units and Lesson Plans for the Garden

Conserving Soil. U.S. Department of Agriculture, Soil Conservation Service. Activities that provide hands on experiments. Students research the history of Native American use of soil. They learn how soil is degraded but also steps to conserve the land for the future.

The Junior Master Gardener Program. This program follows the idea of the Master Gardner Program developed as a U.C. extension course of study for adults. The Junior Master Gardner Program is available through Texas A&M University Extension service. Handbooks are available for teachers and students through their web site: http://juniormastergardener.tamu.edu. Additional information including lesson plans is on the university web site: http://jmg.tamu.edu. The web sites and the handbooks very valuable resources, both as reference tools, and in lesson planning.

Life Lab Science Program. Life Lab has a variety of important resources available.
Their booklet, "Getting Started," offers tips and techniques for getting a school garden started.
The Life Lab web site is: http://lifelab.ucsc.edu

Now We're Cooking! Dairy Council of California (DCC) Nutrition education programs aligned with the Californial Health Framework. The website is: www.dairycouncilofca.org

Nutrition to Grow On: A Garden-Enhanced Nutrition Education Curriculum for Upper Elementary School Children. Department of Nutrition , University of California, Davis. Order from: The California Department of Education, CDE Press, Sales Office, P.O. Box 271, Sacramento, CA 95812-0271.

Project Learning Tree. is a program of the American Forest Foundation and the Western Regional Environmental Education Council. For information on PLT: American Forest Foundation, 111 19th Street, NW, Washington, DC 200036.

The Story of the Sunflower. (701)328-5100. The National Sunflower Association has a blackline work booklet with fun facts about sunflowers. 4023 State Street, Bismark, ND, 58501.

Websites for Gardening With Children

http://aggie-horticultur.tamu.edu/kindergarten/kinder.htm
Even though this site includes kindergarten in the title, there is information and research of interest to teachers at every grade level.

http://www.butterflies.com
Includes a page on plants that attract and feed butterflies and caterpillars.

http://www.cfe.cornell.ecu/compost/schools.htm
Designed for teachers and students, this offering from Cornell University features articles on all sorts of composting topics, including ideas for student research projects.

http://www.greenteacher.com/
This site is directed toward 4th and 5th grades, but the information is valuable at any elementary grade level.

www.nwf.org/habitats/schoolyard/
A project of the Backyard Wildlife Habitat Program, Information on integration of gardening into the classroom.

http://4hgarden.msu.edu/tour/aread.html
The University of Michigan has an outstanding web site showing the layout and development of the 4H Children's Garden. This colorful web site offers information and inspiration.

http://horizon.nmsu.edu/garden/
Hosted by the Smithsonian Institution, this site includes activities, articles, links and grant writing suggestions.

www.kidsgardening.com
Kidsgardening is the on-line gardening journal by the National Gardening Association.

http://www.plt.org/
Project Learning Tree is an interdisciplinary environmental education program.

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